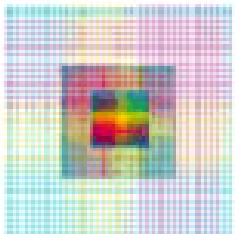

AUDIT II

Country Report
NORWAY

Kari Aamodt Espegren
Final Report 07.06.2002

SUMMARY OF ENERGY AUDITING

The objective of energy efficiency activities in Norway has always been to ensure rational use of energy resources. It is also important to ensure that the measures help to reduce the adverse environmental effects of energy use.

The role of the Ministry of Petroleum and Energy is to ensure that state funds are allocated rationally, draw up a long-term strategy for energy efficiency and renewable energy sources, and evaluate changes in the use of instruments.

The Norwegian Water Resources and Energy Directorate (NVE) have been responsible for administration of governmental efforts in this field. NVE did choose to delegate responsibility for practical implementation of the various measures to operating agents outside the central government administration, and these were appointed in the course of 1995.

The new national Agency for energy efficiency and renewable energy sources - ENOVA - was formally established in June 2001. ENOVA was established to strengthen the public efforts to reduce the environmental impact of energy use and production. The government expects ENOVA to build on the present activities and to come up with initiatives to increase the efficiency of the energy use and the production of energy from renewable sources.

Overview of Energy Auditing in Norway

Energy Audit Programmes

There is no specific Energy Audit Programme.

However, energy audits/energy monitoring are important elements in all Norwegian energy efficiency programmes initiated by the government.

Other Programmes with Energy Audits

Building Network

The Building Network was established in 1997 by NVE's Operating Agent for the building sector to form a basic organisational structure for the Governmental energy efficiency activities in the building sector. The main target groups for the OA for the building sector are private and public owners of non-residential buildings and housing co-operatives.

To be accepted as a full Building Network member, building owners must complete what is called a Networking Process. This is normally a 1,5-2 years process, where the building owners carry out specific activities according to an agreement with the Operating Agent, whereof some are mandatory and others are more on a voluntary basis. The mandatory activities are:

- Define an energy plan/policy
- Establish an Energy Monitoring System
- Routines for Energy Monitoring
- Carry out an Energy Audits
- Initiate Education and Training activities

1670 buildings are presently active within the Building Network, representing about 9,3 mill m^2.

Industrial Energy Efficiency Network (IEEN)

The Industrial Energy Efficiency Network is an industry guided, energy efficiency programme with governmental funding. Established on initiative from the authorities in 1989 to stimulate energy efficiency measures in industry.

The IEEN involves almost 780 member companies from 13 energy intensive industry sectors by January 2002. Membership is free for the industry, and Institute for Energy Technology operates daily management and secretariat services.

The IEEN is 100% funded by the authorities. The budget for 2001 was 2,1 million EUR. This includes both operational costs and grants to member companies. 1,2 million EUR out of this money is used for grants to member companies. The remaining 0,9 million EUR covers the benchmark analysis, documentation of demonstration projects and operational costs.

The audit methodology is based on a two-step approach, starting with a so-called walk-through audit (Phase-1). The second step (Phase-2) requires a more detailed energy audit/analysis of the company, ending up with a comprehensive plan for energy efficiency measures to be undertaken within a given period of time. It is not compulsory to carry out the energy efficiency measures described in the audit report.

The IEEN-companies can receive up to 90% grants of a total budget limited to 3.750 EUR to undertake the Phase-1 audit. Furthermore, they can seek another 50% grant limited to 25.000 EUR to undertake the Phase-2 audits.

Other Activities including Energy Audits

Oslo Econ Fund

The City Council established the Oslo Econ Fund in 1982. Oslo Econ Fund has as its main purpose to stimulate actions that will lead to more efficient use of energy and, if possible, an improvement in indoor and outdoor air quality.

The target sectors for the Oslo Econ Fund are all energy users in Oslo:

- Residential houses
- Non-residential houses (public and private)
- Industry

Regional Energy Efficiency Centres

Pursuant to the Energy Act of 1991, energy utilities, which hold local area licences, are required to implement energy efficiency measures vis-à-vis users in the area. The authorities encouraged the establishment of Regional Energy Efficiency Centres (REECs) to organise regional energy efficiency activities. By the end of 1998 REECs had been established in all 19 counties. The REECs are responsible for local information and training activities. The centres can also provide customers with basic energy advice and -audits. In 2001 the Energy Act was changed and the energy utilities are no longer required to promote energy efficiency measures in their area. In 2002 the REECs will receive funding for their activities by the new governmental energy agency ENOVA. In 2003 their activities will be exposed to competition.

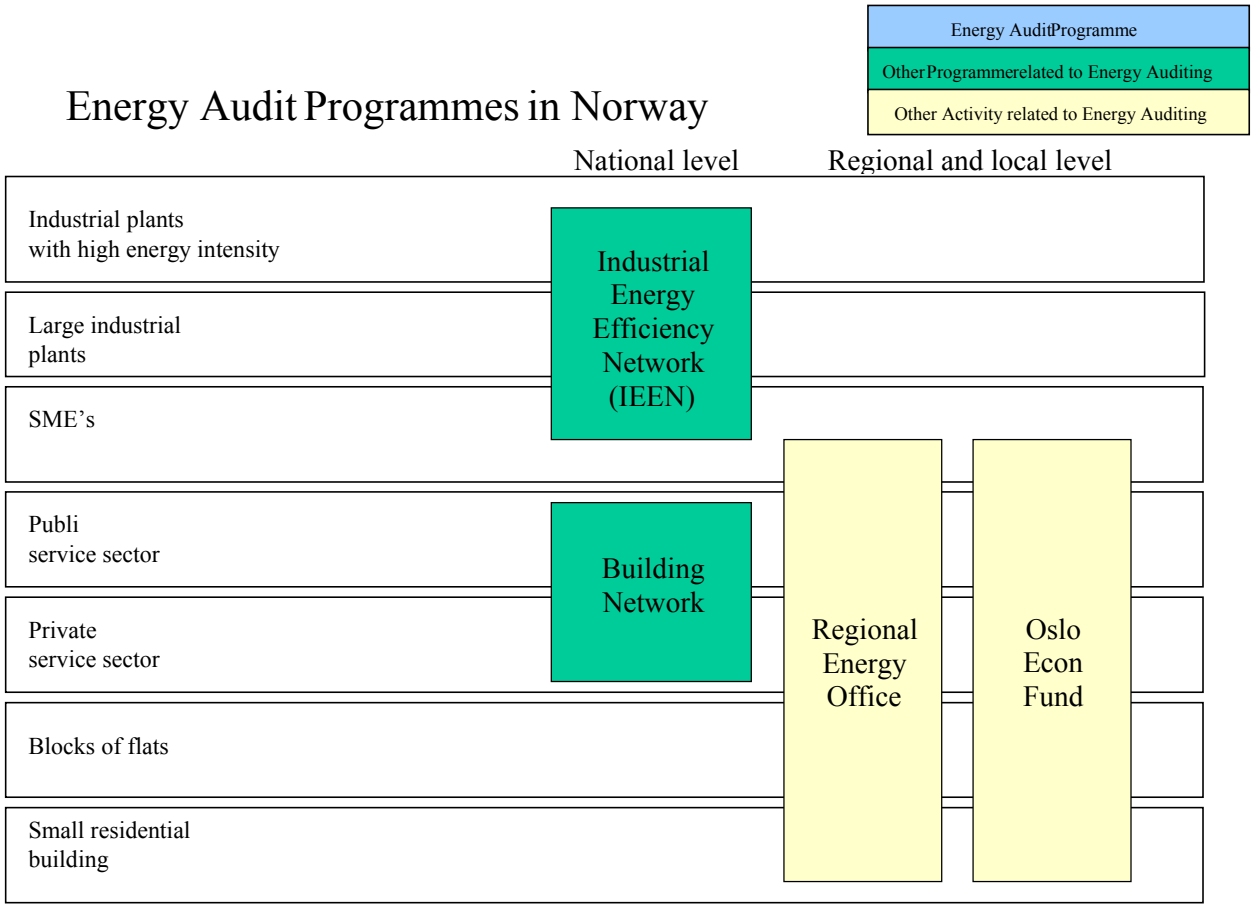

Table of EAP features coverage (Other Programmes with Energy Audits):

	Building Network	**Industrial Energy Efficiency Network**
Status	1996 -	1989-
Administration	Dr.Ing. Ole Gunnar Søgnen	IFE
EA models	++	+
Auditors' tools	+++	+
Training, authorisation	+	+
Quality control	++	+++
Monitoring	+++	+++
Volumes, results	++	++
Evaluation	++	++

+++ = Detailed information available
++ = Some information available
+ = Very little information available
= No information available / does not exist

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Country Report

Country Report written by	Kari Aamodt Espegren	IFE
Based on information from	Hans Ree	Dr. Ing Ole Gunnar Søgnen
	Kari Ekker	Interconsult ASA
	Information gathered	October 2001 – January 2002

Disclaimer

The information contained in this report has been gathered from publicly available sources and through interviews. All efforts have been made to secure the veracity of the report, however the authors cannot guarantee the content.

THE COUNTRY REPORT

Table of Contents

1 Background and Present National Policy

Energy efficiency has been part of Norway's energy policy since the oil crises in the mid-1970s. The governmental funds that have been allocated to energy efficiency measures have varied a great deal. The amounts allocated were particularly high in 1989-1992, when a temporary grant scheme was in operation for energy efficiency measures in private households, the service sector and the industrial sector. In addition to the grant scheme, the state has continuously financed other measures, mainly general information and training activities. In the last five years, the funds allocated to increase energy efficiency and the use renewable energy sources have steadily been increasing.

The objective of energy efficiency activities in Norway has always been to ensure rational use of energy resources. It has also been important to ensure that the measures help to reduce the adverse environmental effects of energy use. Presently, significant emphasis is also placed on increasing the use of renewable energy sources and increasing the flexibility of the end-use heating systems. The latter is important since the predominant energy source for heating purposes in the residential and service sectors is electricity.

1.1 Present national policy and organisation

On 22 June 2001, the new national Agency for energy efficiency and renewable energy sources - ENOVA - was formally established. ENOVA is located in Trondheim, some 500 km north of the Capital Oslo and consist of 20 to 30 experienced professionals.

ENOVA was established to strengthen the public efforts to reduce the environmental impact of energy use and production. The government expects ENOVA to build on the present activities and to come up with initiatives to increase the efficiency of the energy use and the production of energy from renewable sources. In addition, it should focus on increasing the use of natural gas when this is beneficial for the environment. ENOVA's activity will be financed through a state energy fund. In 2002 the fund will receive approximately 62 million EURO (500 million NOK). It is envisaged that the fund will receive approximately the same amount on a yearly basis over a ten-year period starting from 2002. In total the fund will receive close to 620 million EURO (5 billion NOK) over the ten-year period.

ENOVA will emphasise working in a targeted and result oriented manner close to the energy market. It will focus on developing incentive schemes and new markets for energy services and products. It will not be operative in the market itself, but make use of organisations/institutions/enterprises (operating agents) that are willing to compete for assignments and tasks. ENOVA will also act as an advisor for the Ministry, and it will participate in international work in its fields of responsibility. Furthermore, ENOVA will offer a nation wide public information and guidance service. The regional energy efficiency centres would have to compete for this particular task.

ENOVA will be fully operative from January 1st- 2002.

The proposed reorganisation clarifies the present role of the Norwegian Water Resources and Energy Administration (NVE) in having both the regulatory responsibility for the energy market and the responsibility for promoting energy efficiency measures and renewable energy sources at the same time. Figure 1 illustrates the organisational change.

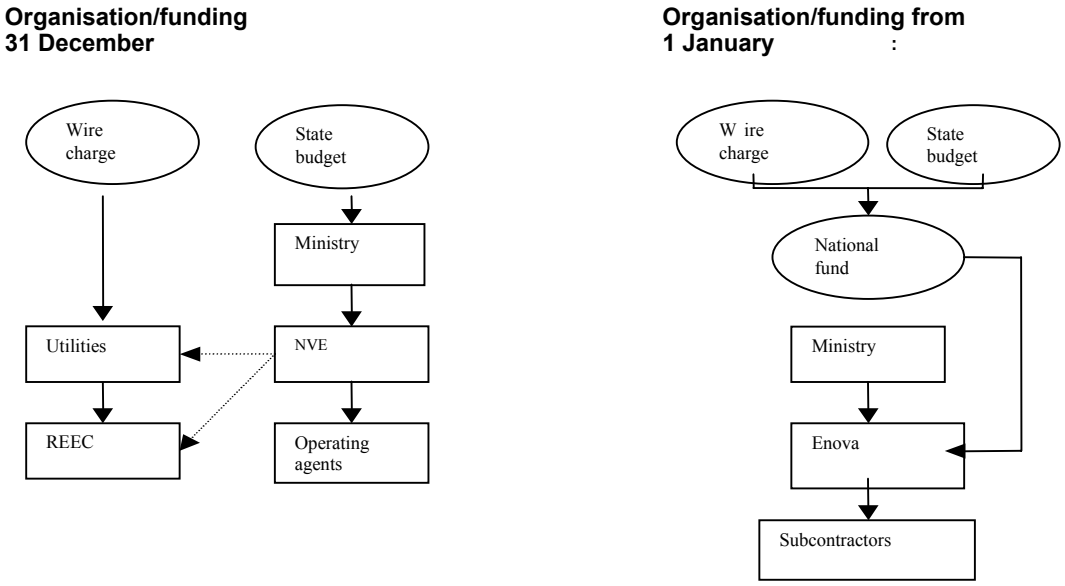


Figure 1. The figure illustrates the past (until 31.12.01) and present (from 01.01.02) organisation and funding of the public energy efficiency and renewable energy work.

One notable change is that the regional energy efficiency centres (REEC), which used to receive funding for their activities directly from their owners, the utilities, now have to compete for the available resources. Furthermore, it is not determined to what extent ENOVA would want to use operating agents. However, the present system with operating agents for buildings, industry, information and training will exist at least until the end of 2002. Consequently, the present programmes will run until the same date. After that the situation is open and it is expected that ENOVA will undertake changes in the organisation, content and set-up of the programmes.

The role of the Ministry of Petroleum and Energy in the new organisational system will be to ensure that state funds are used in a rational, targeted and efficient way. Furthermore, they would have the responsibility for drawing up long-term objectives and strategies for increased energy efficiency and use of renewable energy sources.

The following energy efficiency programmes will be described in detail:

- The Building Network
- The Industrial Energy Efficiency Network
- Oslo Econ Fund

All programmes contain a major Energy Audit element.

2 Energy Audit Programmes

There is no stand-alone Energy Audit Programme.

However, energy audits/energy monitoring are important elements in all Norwegian public energy efficiency programmes.

3 Programmes with Energy Audit

3.1 The Building Network

The Building Network was established in 1997. The objective was to form a basic organisational structure for the Governmental energy efficiency activities in the building sector.

To be accepted as a full member of the Building Network, with the benefits and obligations related to this membership, groups of building owners must complete what is called a Networking Process. This is normally a 1,5-2 years process, where the building owners carry out specific activities according to an agreement with the Operating Agent, whereof some are mandatory and others are more on a voluntary basis. The mandatory activities are:

- Define an energy plan/policy
- Establish an Energy Monitoring System
- Routines for Energy Monitoring
- Carry out an Energy Audit
- Initiate Education and Training activities

Undertaking Energy Audits is one of the central elements of the network.

3.1.1 Programme goals

Energy consumption in the Norwegian building sector amounts to approx 80 TWh or 1/3rd of the total energy consumption in the country. No other sectors have experienced a steeper growth in energy consumption than the building sector the last 30 years. In the administration of the building stock, in construction- and rehabilitation processes, it is the aim of the OA to reveal and overcome barriers to a more efficient use of energy.

3.1.2 Target sectors of the Building Network

The main target groups for the Building Network are private and public owners of non-residential buildings and housing co-operatives. Of the total building stock of 327 million m^2, these groups represent approx 150 million m^2.

1670 buildings are presently covered by the Building Network, representing about 9,3 million m^2, or 6,2% of the target group. All members are obliged to establish an Energy Monitoring System.

Over a 5-year period, measures in these 1670 buildings will produce energy savings of in total approximately 600 GWh each year. Figure 2 shows the distribution of building owners presently active in the Network groups.

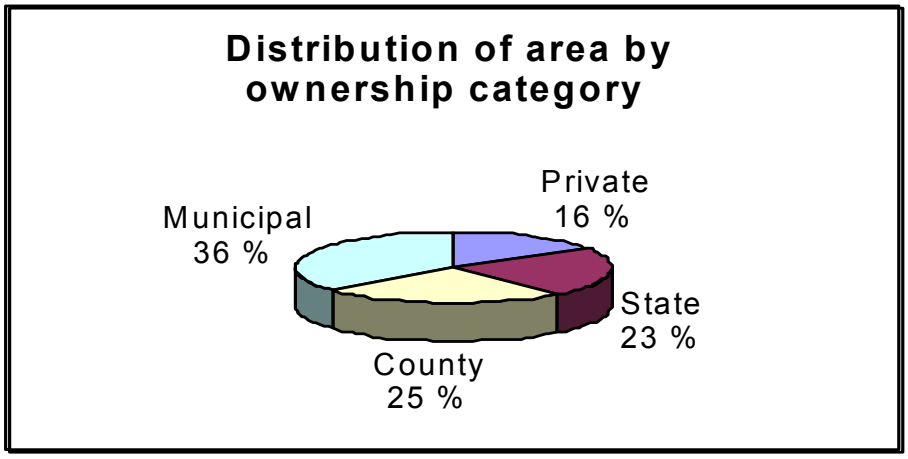


Figure 2. Distribution of area by ownership category in the Building Network (present members)

3.1.3 Administration

The Network is organised as shown in figure 3. NVEs Operating Agent for the building sector, Dr. Ing. Ole Gunnar Søgnen (Company name) is responsible for the overall management of the Building Network. The practical secretariat work is undertaken by contracted Network Co-ordinators with several Network groups established to coordinate the work within the different building groups. The Regional Energy Efficiency Centres (REEC) assist the OA in organising half of these Network groups, the other half is organised by private consultants under contract with the OA.

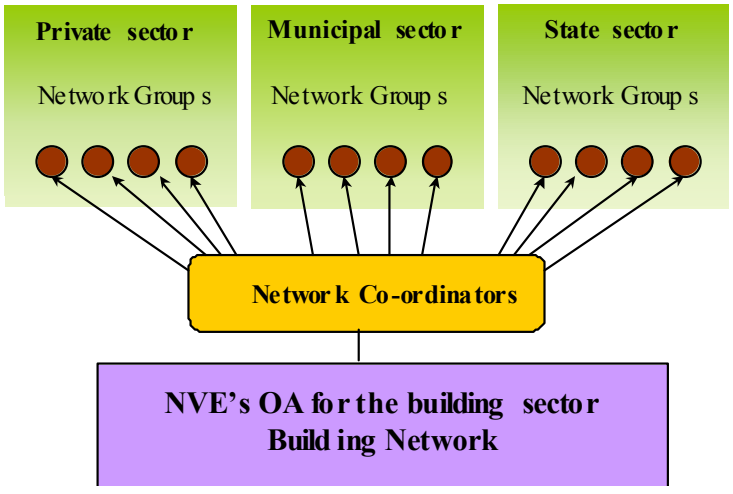


Figure 3. Organisation chart for the Building Network

3.1.4 Implementing Instruments

The Energy Audit is a central element of the building network. To some extent the building network could be said to be the implementing instrument for the Energy Audits. However, the building network is an incentive scheme in its own right, consisting of several elements, which are important for the totality. The Building Network itself is mostly promoted through the Regional Energy Efficiency Centres and other private consulting companies working with energy saving. They contact potential clients to form new network groups and after signing a letter of intention they apply for funds from the OA for the Building Sector.

Financing / subsidies
The OA for the building sector is presently 100% funded by the authorities (NVE/ENOVA). The eligible costs related to the establishment and operation of the Network groups during the 1,5-2,5 years period are 2 MNOK in average. If the Regional Energy Efficiency Centres act as Network group leaders, the Networks can achieve funding also from these centres to undertake auditing activities. These activities must lead to specific decisions by the building owner to implement measures. The audits are 100% funded by the REEC and are split into four different levels as shown in section 3.1.5.

3.1.5 Energy Audit Models

The OA for the Building Sector has developed standard audit models for non-residential buildings, which are mandatory for the building owners to apply during the Network process. The models are distributed for free to all Network groups and members and are available both in paper- and in electronic versions. The audit models will also assist in the production of the periodical report (once a year), which should be submitted to the OA for registration and follow-up.

These audits models are split into four different levels:

1. Walk-through audit and direct recommendation of no-cost/low-cost measures (up to 3 hours).
2. Follow-up with a letter proposing measures (up to 8 hours).
3. Feasibility audit, including on site inspection and concentration on certain measures (up to 15 hours).
4. Full audit (40 hours, audits at this level are exceptions).

The full audit implies a multidisciplinary assessment of the energy situation in the building and the potential for energy savings. The audit is based on information gathered with assistance from the building owner or one of his representatives.

The energy audit procedure is as follows:

- Gather information on energy use, technical equipment, structural material and energy prices
- The survey is important to get the right impression on how the building and the technical equipment are operated.
- Correct energy use with regard to local climate parameters
- Establish an energy calculation model. Building and technical equipment
- Calculate costs and savings of possible energy saving measures.
- Calculate profitability
- Make a priority of the different measures
- Compose the audit report in accordance with the template "Basic Energy Auditing"
- Presentation of the audit and follow-up activities to promote the identified energy saving measures towards the building owner

3.1.6 Auditors' Tools

The OA has initiated and supported the development of a number of guidebooks and training courses aimed at the energy auditors:

- Standardized code in Monitoring Software communication (Guidebook 1998)
- Energy Management (Two Guidebooks 2000)
- Basic Energy Auditing - Reporting (Guidebook 2000)
- Energy Monitoring – Establishment (Guidebook 2001)
- Energy- and Power budgeting (Guidebook 2001)

In addition, the OA have initiated and supported the development of guidebooks aimed at the building owner and building operator. These guidebooks help the building owner/operator to understand the auditing process, and gives advice on how to continue the energy efficiency work when the auditor has finished the energy audit:

- Energy Management (training course material)
- Energy Monitoring – Building owners (Guidebook 1998)
- Energy Monitoring – Operators (Guidebook 1998)

3.1.7 Training and authorisation of the auditors

All auditors are trained and qualified for auditing activities within the framework of the REECs' courses and training programmes. Apart from these training courses there are in principle no formal requirements for being authorised for auditing services. This is due to the fact that most of the audits are carried out by the REEC's own personnel.

The OA has initiated and supported the development of a number of guidebooks and training courses aimed at the energy auditors:

- Energy planning (Guidebook 1998)
- Energy Management (training course material)
- Energy Management (Two Guidebooks 2000)
- Energy Monitoring – Establishment (Guidebook 2001)
- Basic Energy Auditing (Guidebook 2000)
- Energy- and Power budgeting (Guidebook 2001)

The OA advise the energy auditors to use the methodology described in the guidebooks.

There are specific courses for the building owners and their technical staff. These courses are tailored to the different network groups and is arranged for each group after a prepared plan:

- 2-day courses
- Courses in energy management, energy monitoring and miscellaneous technical issues
- 15-20 attendants on each course
- 5 courses pr network group
- Normally 2-3 years between the first and last course

3.1.8 Monitoring

During the course of Network processes, the Network co-ordinators are responsible for the collection and registration of energy data for each building. When this initial Network process is over and the building owners become full members of the Building Network, the Regional Energy Efficiency Centres will take over the responsibility for following up each individual building owner in his monitoring efforts. The REECs will furthermore assist in the registration procedures related to the annual submission of energy data to the Building Network.

The Building OA monitors the whole scheme by meeting with the different Network group leaders at least once a year, complemented by telephone interviews whenever considered necessary.

In 2000 a total of 1039 buildings participated in the final annually energy statistics report. These buildings consumed 1378 GWh. For 2001 it is expected energy statistics report from 1400 buildings.

The results of the Energy Audits are not separately monitored.

The total energy savings are 100 GWh per year. The total costs of running the building network are 2 MEUR (15-16 MNOK) per year. This implies public support of 0,02 EUR per saved kWh (0,15 NOK/kWh).

3.1.9 Auditing Volumes

The audited volume of buildings is rising fast and is becoming a significant resource for the energy statistics in Norway. The systematic approach and the establishment of network groups for different building categories is a good basis for an even larger volume in the future. The table bellow shows the number of audited buildings and heated floor area by building category in the Building Network in 2000.

Code	Building category	Number	Heated area m2
	Total	**1 039**	**5 795 800**
2	**Industry and storehouses**	**21**	**58 200**
3	**Offices and commerce**	**180**	**1 278 500**
31	Office buildings	143	1 124 200
32	Commercial buildings	37	154 300
4	**Communication**	**34**	**150 200**
41	Dispatch buildings	24	121 200
42	Parking houses, hangars	6	17 700
43	Road authority buildings	4	10 900
5	**Hotels and restaurants**	**55**	**241 700**
51	Hotel buildings	12	141 700
52	Accomodation building	35	82 000
53	Restaurant building	8	18 000
6	**Culture and Research**	**595**	**2 841 400**
61	School buildings	479	2 135 600
62	University buildings	50	503 000
64	Museums and library buildings	6	28 500
65	Sports buildings	43	138 600
66	Cultural buildings	13	28 800
67	Buildings for religious activities	3	1 300
7	**Health**	**135**	**1 028 200**
71	Hospitals	15	565 600
72	Nursing homes	111	451 300
73	Health centres	9	11 400
8	**Prisons, emergency**	**6**	**31 000**

3.1.10 Results

The table shows the specific energy consumption in 1999 and 2000 adjusted to normal climate for qualified buildings in the Network.

Code		Number	Total temp. adjusted specific energy consumption [kWh/sq m] 1999	2000	Percent change (%)
	All buildings	**718**	**256,8**	**247,5**	**-3,6**
21	Industry buildings	8	344,4	367,4	6,7
23	Storing building	11	326,7	267,5	-18,1
31	Office buildings	109	242,2	227,3	-6,1
32	Commercial buildings	17	436,2	446,0	2,3
41	Dispatch buildings	19	388,4	399,1	2,8
43	Parking and hangars	5	364,8	319,4	-12,4
51	Hotel buildings	7	346,9	324,1	-6,5
52	Accommodation buildings	29	282,8	228,4	-19,3
53	Restaurant buildings	8	567,9	482,3	-15,1
61	School buildings	316	203,0	197,5	-2,7
62	University buildings	28	285,4	289,1	1,3
65	Sports buildings	31	362,4	360,3	-0,6
66	Cultural buildings	10	231,5	238,5	3,0
71	Hospitals	8	364,4	337,5	-7,4
72	Nursing homes	78	307,9	304,3	-1,2
73	Health centers	6	177,2	195,2	10,2
82	Prisons, emergency	6	272,8	228,0	-16,4

The results are in total. There does not exist any breakdown on activity, i.e. heating, lights.
In average the energy savings due to motivation, education, energy audits and accomplished measures are 100 GWh per year. The results of the energy audits are not separately monitored.

3.1.11 Evaluation

Based on an evaluation in 1999/2000 initiated by the Government, the Building Network was highly appreciated among participating building owners and consulting companies. The success is based on not only the energy savings but also the fact that professionals are working together in new forums and sharing knowledge and experience.

3.1.12 Future plans

Just as in the Norwegian Industrial Energy Efficiency Network, the annual energy benchmarking will also form the basis activity within the Building Network in the future. The combination of continuous monitoring within the company/building and annual reporting/feedback in terms of benchmarking within comparable groups of energy users has proven to be a valuable tool for improving energy efficiency.

The Building Network will continue in its present form at least in 2002. Enova will later on decide whether to support the continuation of the Building Network from 2003 and further on.

3.2 The Industrial Energy Efficiency Network

The Industrial Energy Efficiency Network (IEEN) is an industry guided, energy efficiency programme with governmental funding. Established on initiative from the authorities in 1989 to stimulate energy efficiency measures in industry. The IEEN is 100% funded by the authorities.

The IEEN involves 780 member companies from 13 energy intensive industry sectors (15.02.02). Membership is free for the industry, and Institute for Energy Technology operates daily management and secretariat services.

The Energy Audit Programme
The most important feature in the IEEN is the Energy Audit Programme. The intention of this support scheme is to realise the industrial companies energy efficiency potential. Through implementation of an energy management system and accomplishment of an energy audit the industrial companies will be able to carry out economically viable investments and activities with regard to energy efficiency.

Within the framework of the support scheme companies receive economic support after the implementation of energy management and after the accomplishment of the energy audit.

The Energy Audit Programme in the network was launched in 1996.

3.2.1 Programme goals

The Industrial Energy Efficiency Network is the most important energy efficiency measure aimed at the industry. One important objective for the Governmental energy efficiency activity is to stimulate the industry to carry out economically viable investments and activities. In this respect, the Industrial Energy Efficiency Network can assist the industrial companies in acquiring better knowledge with regard to their energy consumption and put a focus on technologies that contribute to more efficient energy consumption.

There have only been set quantitative goals for the Energy Audits the last years. For the period 2000-2002 the goals are as shown in the table:

Goals	**2000**	**2001**	**2002**
Identified potential for energy efficiency (GWh)	300	300	300
Identified energy efficiency measures (GWh)		200	200
Realised energy savings (GWh)		100	100

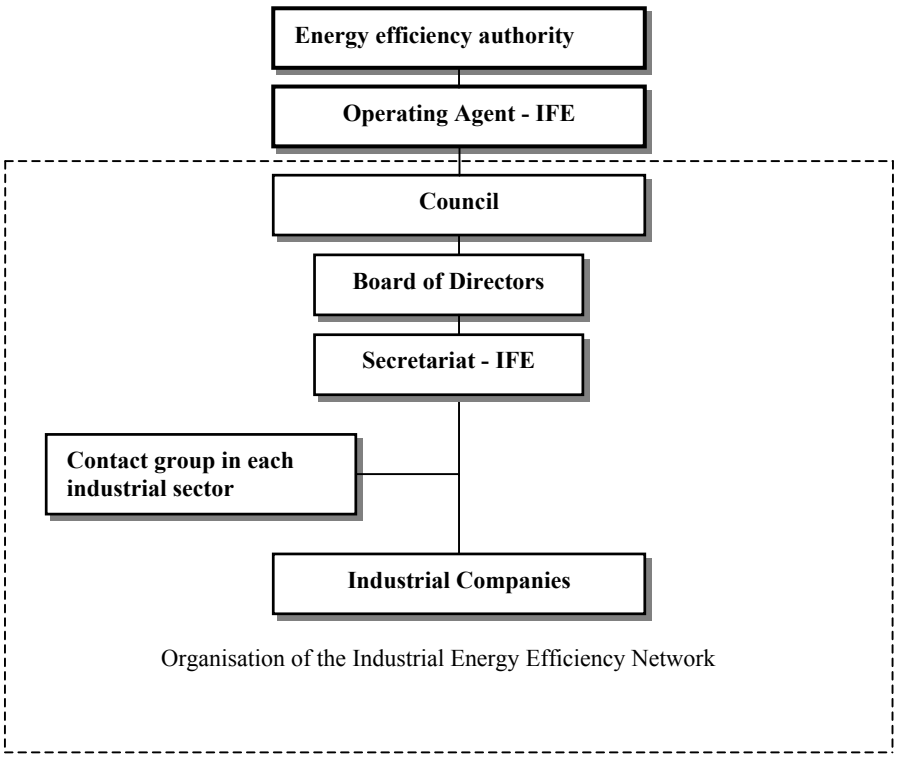
3.2.2 Target sectors

The target sectors for the Industrial Energy Efficiency Network are both small and medium sized enterprises and energy intensive industries. The target sectors are:

- Aluminium industry
- Pulp and paper industry
- Foundry industry
- Engineering industry
- Timber and sawmill industry
- Bakeries
- Brewery industry
- Fish industry
- Meat industry
- Grain-drying industry
- Dairy industry
- Fish meal industry
- Laundries and drycleaners

3.2.3 Administration

Institute for Energy Technology (IFE) is operating agent for the industry sector, thus being responsible for carrying out measures in order to stimulate the industry to become more energy efficient and environmentally friendly. The Industrial Energy Efficiency Network is organised with a Council with representatives from all the participating industry sectors, a Board, Contact Groups for each industrial sector and the Secretariat (IFE).



Organisation of the Industrial Energy Efficiency Network

3.2.4 Implementing instruments

The Energy Audit is a central element of the IEEN, but the IEEN is an incentive scheme in its own right.

By joining the IEEN, the companies commit themselves to submitting energy and production data, introducing an energy management system and establishing a plan for their energy efficiency efforts in the short and medium term. In exchange they will receive a benchmarking analysis and access to certain subsidies for establishing an energy monitoring system and undertaking an energy audit.

The Energy Audit Programme in the IEEN is promoted through articles in industrial magazines, information to the trade organisations, information in industrial workshops and seminars and by private consulting companies working with energy efficiency and energy audits.

Financing/Subsidies
From 1996 there have been direct grants to the member companies within the Energy Audit Programme. The annual budget for this activity has varied between 4 and 10 million, see figure 4. The grants to industry are subsidy of the Energy Audit and investment support for an Energy Monitoring System.

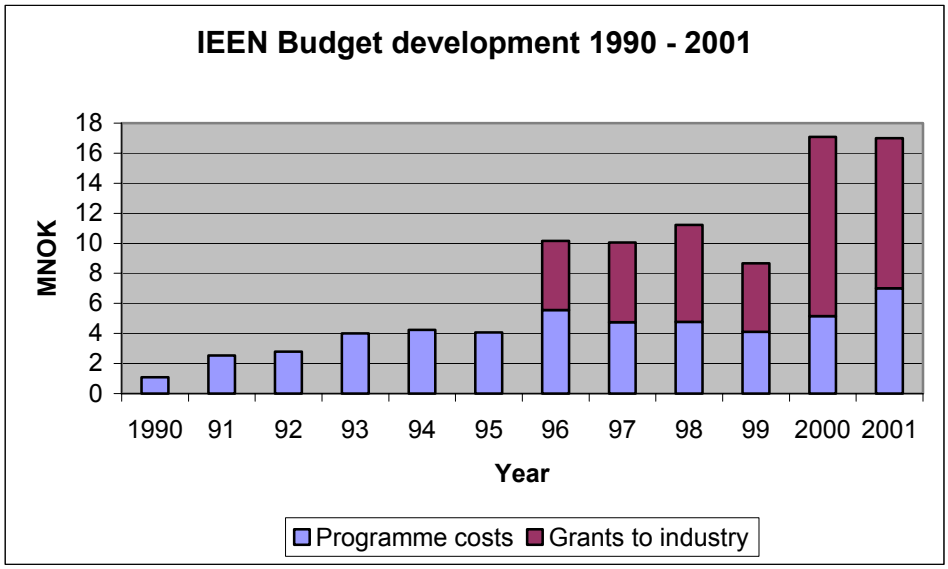


Figure 4. IEEN - Budget development 1990-2001.

The budget for 2002 is 2,8 mill EUR (23 million NOK), of which 1,2 MEUR is set aside for economic support to industry for energy audits. The remaining amount covers the benchmark analysis, documentation of demonstration projects and operational costs.

The IEEN-companies can receive up to 90% grants of a total budget limited 3.750 EUR to undertake the Phase-1 audit. Furthermore, they can apply for another 50% grant of a total budget limited to 25.000 EUR to undertake the Phase-2 audit. For large companies or industrial companies with complicated industrial processes this limit can be increased.

Mandatory / legal schemes	Voluntary schemes
No links to mandatory or legal schemes	The Energy Audit Programme within the IEEN is a voluntary scheme
Fiscal incentives (taxes)	**Fiscal incentives (subsidies)**
There exists no link to the tax scheme.	Subsidies up to 50% (max 28.750 EUR)
Marketing tools	**Policy issues**
Information to IEEN member companies. General information available: internet, brochures	The energy efficiency policy is to reduce the environmental impact of energy use and production. No specific links to Energy Audits.

3.2.5 Energy Audit Models

The Energy Audit Model is developed for industrial companies in general, however the same approach are now being used in the building sector in Norway. The methodology is based on a two-step approach, phase-1 audit and phase-2 audit.

Phase-1 audit
The first step in the energy audit is the so-called walk-through audit (Phase-1). This phase includes the installation of free-of charge Excel spread sheets specially developed for energy management in each sector. The companies can receive up to 90% of the costs related to Phase-1, limited to total eligible cost of 3.750 EUR.

The Phase-1 audit comprise two main activities:

- Establish Energy Management in the industrial company
- Rough mapping of the main water and energy flows in the company. Benchmark company-data with best practice companies in the same sector and identify main areas for improvements (industrial processes, water treatment etc.)

Phase-2 audit
The second step (Phase-2) requires a more detailed energy audit of the company, ending up with a comprehensive plan for energy efficiency measures to be undertaken within a given period of time. The companies can seek up to 50% subvention for this phase, limited to total eligible cost of 25.000 EUR. For large industrial companies this amount can be increased on the basis of the companies total energy consumption and on the identified energy potential in Phase-1.

The Phase-2 audit comprise the following activities:

- Develop detailed energy and mass balances
- Identify and prioritise specific measures. In principle all energy using processes are covered
- Identify water use and specific water reducing measures in industrial companies with a large water consumption
- Prepare material for decision-making with regard to investments and implementation of measures

3.2.6 Energy Audit Tools

Phase-1 audit
IFE has worked out a guidebook/handbook regarding energy management in industry. Approx. 75 energy advisors in the Network have attended a seminar to learn the idea and concept of energy management in industry. The advisors are recommended to follow the procedure described in the handbook when they accomplish the Phase-1 audit.

Energy Monitoring System
IFE has developed an Excel Workbook (with regression analysis) for weekly follow-up by the industrial companies. This tool is recommended, but not mandatory.

Phase-2 audit
There are no compulsory or recommended tools.

Most of the consultants/auditors have their own tailor-maid tools. For example, they have developed their own software, for instance to simplify the preparation of detailed energy and mass balances.

3.2.7 Training and authorisation of the auditors

Within the framework of the IEEN Energy Audit Programme, a group of 75 consultants has been pre-qualified to assist the industry in implementing Energy Management. These consultants have been specially trained in using an IFE developed methodology for the implementation of Energy Management.

The basic requirements for the auditors are in general that they have documented merits in actively performing energy/environmental consultancy services to the industrial sector. Furthermore, auditors have to attend IFE's training courses prior to being pre-qualified as IEEN-consultant. The training course has traditionally been a one-day course dealing with industrial energy management and routines regarding the Energy Audit Programme. From 2001 the training course is available as an interactive course with use of CD and Internett.

To give the auditors a possibility for exchange of experience and to train them in specific technological items, IFE once a year arranges a training course/workshop for the consultants/auditors. These seminars cover different issues with regard to energy efficiency in industry. Participation is strongly recommended, but still voluntary.

Quality Control
IFE is responsible for the quality control of the energy audits. It is important to have a detailed quality control, since it is easy to be registered as an auditor within the Energy Audit Programme.

The quality control of the energy audits is as illustrated in the diagram:

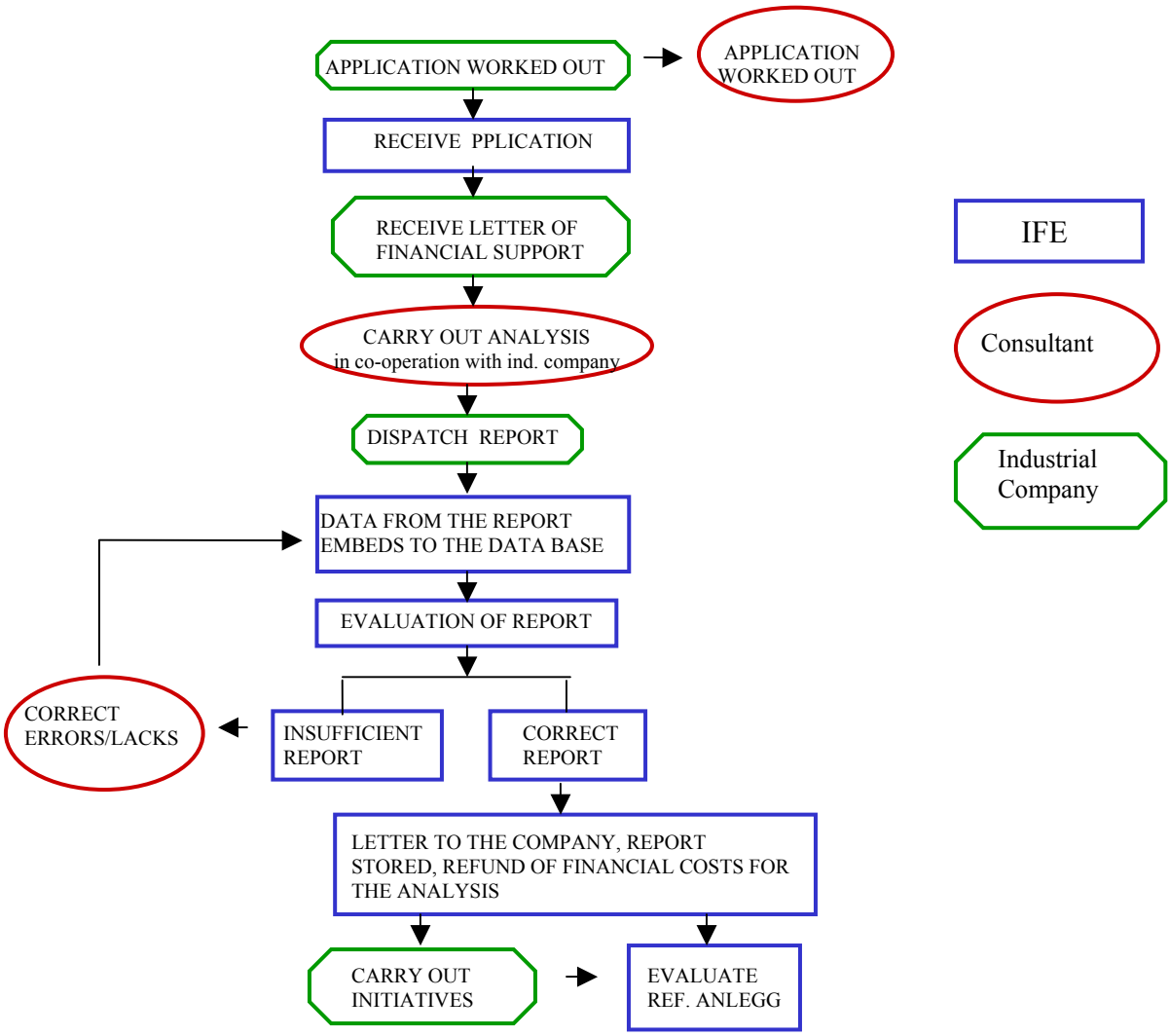


Figure 5. Illustration of the procedure of quality control in the Energy Audit Scheme

3.2.8 Monitoring

Monitoring of the Scheme

With regard to the monitoring of the IEEN itself, this is handled by the Network's advisory board, representing all the participating industrial sectors. The Network secretariat (IFE) submits an annual statement to the advisory board, describing the objectives pursued, measures taken, financial attributes and number of audits undertaken within the different sectors during the last year.

The advisory board forward this statement further to NVE/ENOVA for approval and accounting.

An important element in the monitoring of the scheme is the Access database. The database contains information on energy consumption, different energy carriers,

production volumes, energy saving measures and energy saving potential from 1990 and up to 2001. Approximately 750 industrial companies are registered in the database.

Monitoring in the companies

If we shall be able to monitor the effects and results of the Energy Audit Programme, we are dependent on monitoring within each company. As shown in figure 6 there are rather big variations in the level of Energy Monitoring System (EMS) implementation between the sectors. The majority of companies, 42% do energy monitoring on a monthly basis.

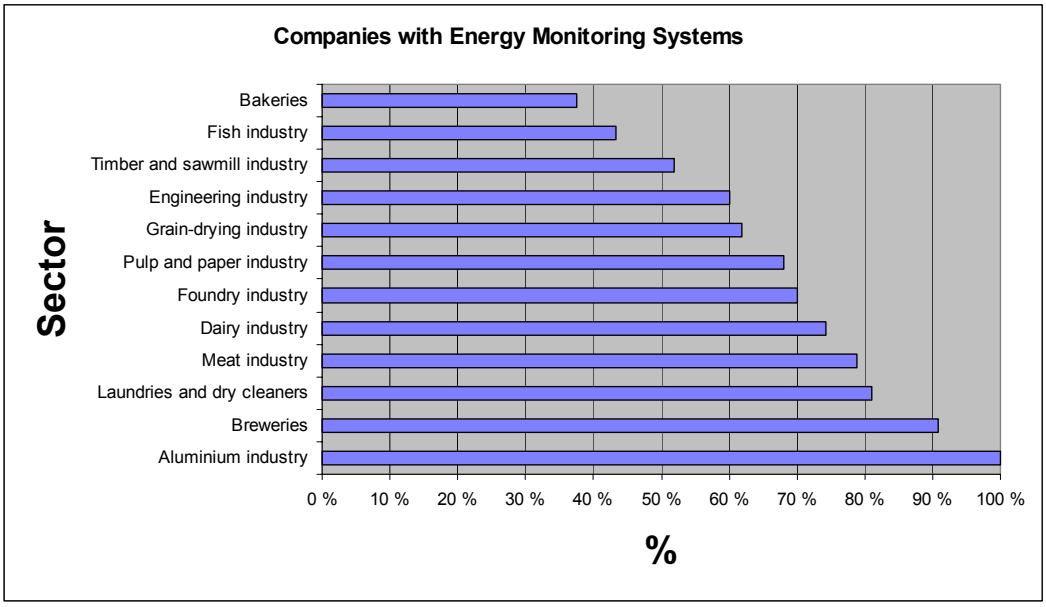


Figure 6. Energy Monitoring Systems (EMS) in industry sectors

3.2.9 Auditing Volumes

In total, almost 440 companies within the Industrial Energy Efficiency Network have taken benefit from the Energy Audit Programme to establish energy management. After the energy management system has been established 130 companies have continued to the second phase and have been supported to accomplish an energy audit. In addition, nearly 150 industrial companies have received support for establishing an Energy Monitoring Systems – EMS.

However, there are great variations in how interested member companies are in making use of the available means. There are also large individual differences in the level of activity among the 75 qualified consultants/auditors. The table shows the number of companies supported by the Energy Audit Programme and the economic support divided on the different industrial sectors.

Sector	Phase 1	EMS	Phase 2	Contracted amount EUR
Bakeries	24	5	1	92.000
Brewery industry	10	5	4	104.000
Fish industry	92	25	35	688.000
Meat industry	30	17	12	292.000
Grain-drying industry	43	13	18	336.000
Dairy industry	43	29	23	530.000
Engineering industry	26	16	11	319.000
Aluminium industry	1	1	1	22.000
Fish meal industry	7		1	34.000
Foundry industry	7	4	3	64.000
Pulp and paper industry	20	9	7	309.000
Timber and sawmill industry	47	7	6	203.000
Laundries and drycleaners	27	8	12	183.000
Other industrial sectors	172	40	23	1.119.000
Total	**438**	**149**	**131**	**4.295.000**

Number of companies supported by the Energy Audit Programme in the different industry sectors and economic support.

3.2.10 Results

The number of Network members is increasing every year. By 2001, the IEEN companies represent 50 % (37 TWh) of the energy consumption in Norwegian industry.

The energy statistics for the Industrial Energy Efficiency Network in 2000 are based on energy- and production data, which was reported by 80 % of the members. Energy consumption per produced unit (specific energy consumption) is used as an indicator of the energy efficiency development. A majority of the members can refer to positive results in terms of increased production and reduced specific energy consumption. Figure 7 shows the development in the specific energy consumption compared to the reference year 1995.

The total energy savings in industrial companies reporting energy and production in both 1995 and 2000 are 700 GWh[1].

[1] Energy savings= 700GWh = (specific energy consumption1995 – specific energy consumption2000) x production2000.

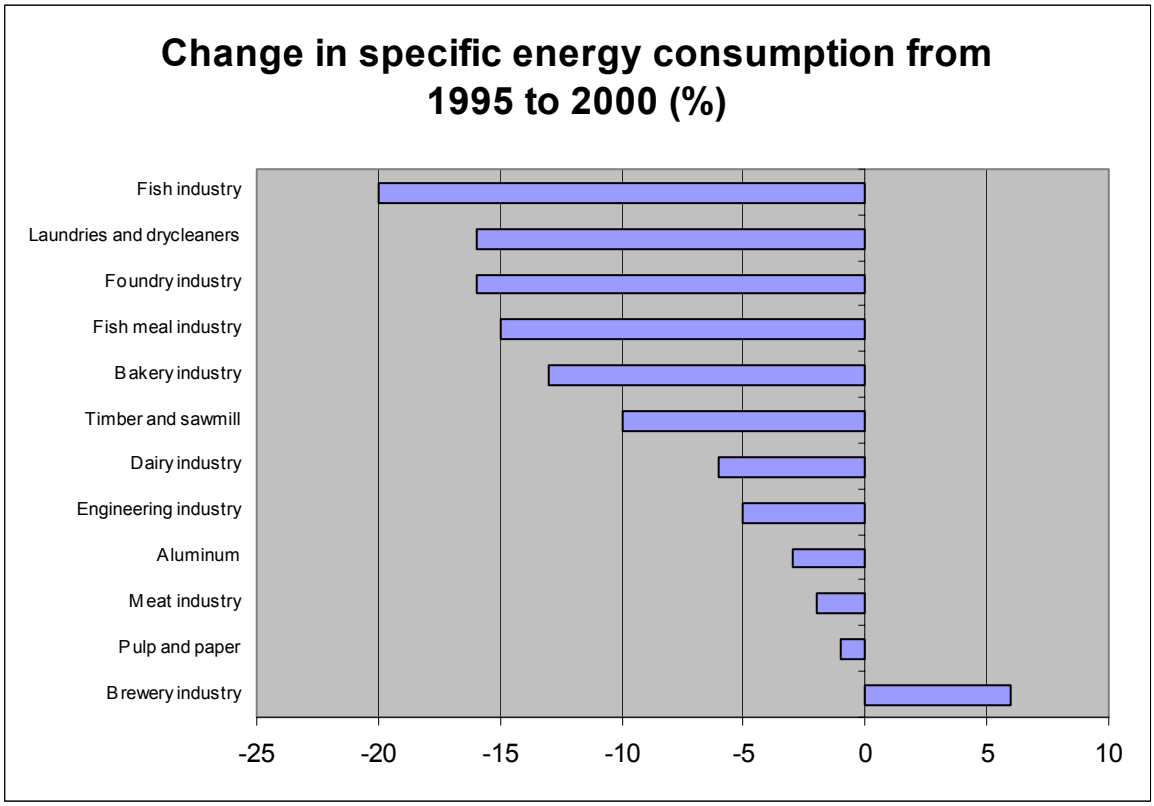


Figure 7. Development of specific energy consumption compared with the reference year 1995. The basis for the calculation is gross energy consumption per unit produced.

The results are sensitive to the choice of reference year, energy products and sample of member companies, yet it gives an indication of the development with regard to energy efficiency in industry.

The achieved reduction in specific energy consumption is a result of different means in the industrial energy efficiency network, such as benchmarking, energy audits, workshops, seminars and "best practice" information pamphlets. However, a large amount of the savings is a result of the energy audits.

Results of the Phase-1

In order to measure the results of the Energy Audit Programme, two groups of companies have been compared. One group comprises 64 companies that have implemented a phase-1 audit in the period 1996-1998, while the second group comprises 171 companies that have not implemented any form of audit or have done so since 1998. Both groups have reported energy and production figures for 1995 and 1999. The change in specific energy consumption from 1995 to 1999 has been calculated for each company. The average change has then been compared for the two groups.

The average change for the group of companies that have implemented a phase-1 audit is 7 %. The second group recorded an average change of –1%.

Using this calculation method, the results of the Pase-1 of the Energy Audit Programme can be estimated as equivalent to an increase of 6 % in energy efficiency in the individual company.

Results of Phase-2
The results of the Phase-2 audit have not been analysed in the same way as the Phase-1 audit. In the audit reports from Phase-2 the consultant describes different energy efficiency measures to be carried out by the company.

It is mandatory to carry out the Phase-1 audit before the companies can start the Phase-2 audit. Due to this, there were not many Phase-2 audits carried out the first years of the Energy Audit Programme. However, there has been an increase in phase-2 audits the last few years, and the total number of phase-2 audits is 130.

The total energy savings are around 140 GWh. The energy savings are calculated on the basis on accomplished measures. In addition, the results are controlled by the annual energy report from each member company in the network.

3.2.11 Evaluation

An independent consulting company evaluated the Industrial Energy Efficiency Network and the Energy Audit Programme in 1999/2000. The conclusion from the evaluation is as follows:

- Companies have more motivated staff
- The knowledge of energy efficiency measures is increased
- Specific energy consumption is reduced in member companies

The recommendation from the evaluation is:

- Focus even more on energy savings
- Alternating focus on between different industrial sectors
- Strengthen the Energy Audit Programme

3.2.12 Observations and Future Plans

The new national Agency ENOVA was established to strengthen the public efforts to reduce the environmental impact of energy use and production. ENOVA will build on the present activities but will also come up with new initiatives to increase the efficiency of the energy use and the production of energy from renewable sources.

ENOVA will emphasise working in a targeted and result oriented manner close to the energy market. It will focus on developing incentive schemes and new markets for energy services and products.

As there still are a large potential for energy efficiency within Norwegian industry, we expect ENOVA will give priority to activities towards the industry.

As previously described, the IEEN is an organisational structure to which the government can apply any specific measure targeting the industrial sector. Both the IEEN and the Energy Audit Programme can easily adopt new means, such as the environmental dimension, and integrate it into the existing activities.

4 Other Activities including Energy Audits

4.1 Oslo Econ Fund

Hilde Lynnebakken, Oslo Energi Enøk AS
Revised by Kari Ekker, Interconsult ASA 31.08.01

Electricity is the main energy carrier for stationary use in Oslo, accounting for 8,7 TWh in 2000. The domestic sector represents 50% of the stationary energy use in Oslo, manufacturing 15%, and services 35%. Electricity is widely used for heating purposes in Norway. Fossil fuels for stationary use is Oslo account for 1,3 GWh. There are four district heating systems, partly interconnected. District heating in Oslo was mainly built after 1982, and is still increasing. More than half of the heat is provided by waste incineration. Bio energy, mainly traditional wood, provided 0,7 TWh in 2000.

4.1.1 Programme goals

The objective of the Oslo Econ Fund was from the beginning in 1982 to reduce the growth in electricity demand to zero. Later, the objective has been revised. The current objective of the fund is, as adopted by the City Council:
The purpose of the Oslo Econ Fund is to stimulate actions that will lead to a reduction in consumption of energy, or more efficient use of energy, and to improve air quality indoors and outdoors.

4.1.2 Target sectors of the Oslo Econ Fund

The target sectors for the Oslo Econ Fund are all stationary energy users:

- Residential houses
- Non-residential houses (public and private)
- Industry

4.1.3 Administration

The City Council established the Oslo Econ Fund in April 1982, at first for a period of three years, with a yearly budget of around 7,5 MEUR (60 MNOK). This amount corresponded to a levy of 0,00125 EUR/kWh (0,01 NOK per kWh) of electricity consumed. The fund was made permanent in 1984.
After the deregulation of the energy market in Norway, the City Council decided to move the fund from the utility to an agency within the municipal bureaucracy. The daily management of grants, loans, financing of pilot projects etc. are bought as a service. For the time being, Interconsult ASA, a privately owned consultancy firm, carries out the daily management of the fund. As a result of this Interconsult cannot undertake energy audits in Oslo, or rather cannot obtain support for their energy audit work in Oslo.

Capital from the fund finances the administration of the fund, approximately 1,25 MEUR per year (10 MNOK per year).

The City Council approves the regulations concerning the fund and the yearly budget. An important part of the regulations is the different actions that may be supported:
- Energy audits
- Investments in buildings and systems
- Research and pilot projects
- Information
- Education

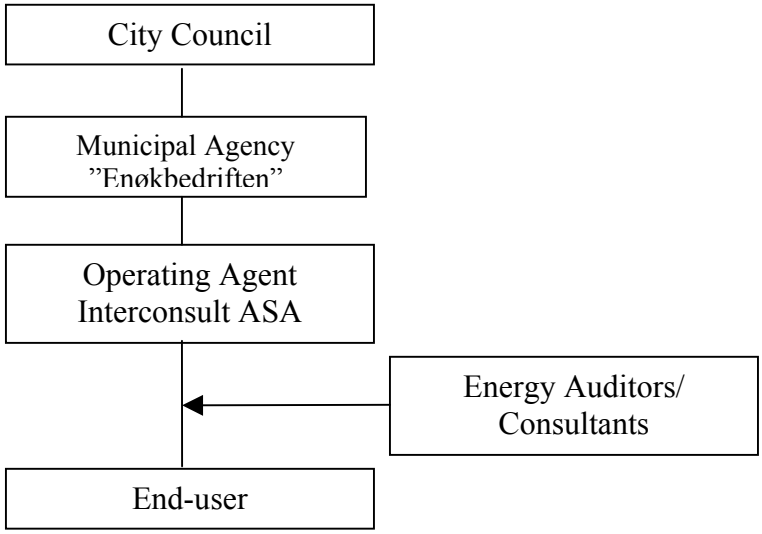


Figure 8. Organisation of the Oslo Econ Fund

4.1.4 Implementing instruments

Financing
The most important use of the fund is providing grants and loans for investments in energy efficiency measures. As figure 9 shows, grants given from the Oslo Econ Fund varies from year to year. The grants per year have varied from 0,5 MEUR to 7 MEUR in the period from 1990 to 2000. In the same period the loans have varied from 0,1 to 7 MEUR.

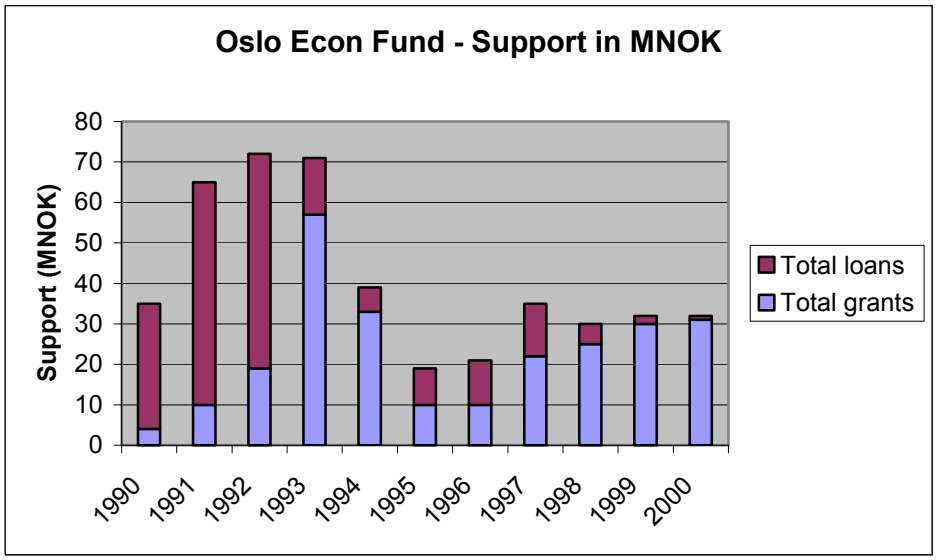


Figure 9. Support from Oslo Econ Fund – 1990-2000

Total grant from the fund in 2000 was 3,9 MEUR (31 MNOK). In addition the fund paid for the administration of the fund, approximately 1,25 MEUR per year.

To decide the amount of grant that may be given to a project, a standardised procedure is followed. Simple rates are given for each possible energy efficiency measure, based on the savings potential for the measure. The grant for investing in new windows is, for instance, given as an amount per square metre.

To receive grants from the fund, an energy efficiency audit is mandatory, except for the household sector (dwellings, etc). The fund covers 80 % of the costs of the auditing, and the owner covers 20 %.

The auditors get 80 % of their expenses covered when the audit is finished, and 20 % when the energy efficiency measures are implemented and the final report is accomplished. The final report describes which measures that are carried out.

The consultant firms must enter into framework agreements with Interconsult. To achieve this, the firms must meet certain requirements with regard to their competence and documented results.

4.1.5 Energy Audit models

There is no stepwise approach. The audit is a full-scale audit adapted to the object, i.e. a large office building would require more than a simple block of flats. All potential measures are covered, e.g. increased insulation, renovation of the ventilation systems, heating systems, etc. The auditors have to use the procedure described in *The Energy Efficiency Handbook ("Enøkhåndboka")* when they accomplish the energy audit.

The resulting audit report is an important document, not only to decide the size of the grant, but also to motivate the building-owners to implement energy efficiency

measures. The report will display in detail which measures that would be worthwhile implementing from an economic perspective.

The report describes the current condition of the building (regarding energy use) and lists all recommended energy efficiency measures. For each measure, required investment, expected energy savings, amount of grant (and loan) funding available and profitability are listed.

The amount of grant funding for each measure is based on the expected kWh-equivalent savings. For convenience and to ease communication with the building-owners, the rates are given as a percentage of the cost or as an amount per unity. The expected energy savings however, also limits the amount of grant funding.

A system for measuring and analysing energy use is considered a very important energy efficiency measure. Experience shows that a control system reduces the energy use by 5-10 percent. Therefore, the implementation of a system for tracking energy use is considered in all projects. For most buildings, this measure must be implemented before grants are paid. In addition, the energy monitoring system helps revealing new possible measures and documents whether the calculated savings are actually achieved. The system is very simple: The user registers the energy use and outside temperature once a week (or day or month.) Plotting the results in an energy-temperature diagram gives, after some time, the building's normal energy use for that temperature. Later, if the user gets a deviation from the normal value, he or she will know that there is something unusual. This energy control system is also supported by the fund.

4.1.6 Auditors' tools

The auditors have to use the energy efficiency handbook (Enøkhåndboka) as described in chapter 4.1.5 when conducting an audit. It is also mandatory to write the audit report after a specific report template called *"Mal for Enøkrapport"*.

4.1.7 Training, authorisation and quality control

Interconsult ASA co-operates with a network of approximately 20 consultant firms that carries out the audits. The owner chooses the firm himself. The consultant gets 80 % of his/her expenses covered when the audit is finished. The consultant gets the last 20 % when the energy efficiency measures are implemented and the consultant writes a final report.

Annually, Interconsult makes an announcement for energy consultants. The consultant firms enter into framework agreements with Interconsult. To achieve this, the firms must meet certain requirements with regard to their competence and documented results.

Increasing knowledge and awareness among caretakers is considered a very cost-effective measure. Combining national financing with the fund, caretakers in Oslo may attend free courses. The courses are getting more popular as the marketing of the courses is increased. In 1997, 523 persons participated in 32 different courses. In 2000,

there were about 430 persons participating in different Energy Efficiency courses. The decrease in participants may be because the courses are no longer free, although the course fee is no more than 500 NOK (62 EUR) per day.

Quality Control
The quality control is part and parcel of the procedure to apply for grants from the Econ Fund. The procedure is as follows:

1. An agreement for an energy efficiency audit is made between a consultant firm and the owner of the building. The agreement is approved by Interconsult.
2. The consultant firm conducts the audit. The resulting report is examined by Interconsult, and an application form is made based on the measures proposed in the report.
3. The report and application form is presented to the owner who decides which energy efficiency measures are to be implemented and sends an application for grants and/or loans to Interconsult.
4. Interconsult evaluates the application and sends a recommendation to Enøkbedriften who gives an advance promise of grants.
5. After implementation, the consultant inspects the work and makes a completion report. This report is signed by the owner and the consultant and is sent to Interconsult.
6. The payment of grants is made after approval of the completion report.

4.1.8 Monitoring

No specific target is set for the energy audit scheme. There is at budget that limits the number of audits that can be carried out. The target is of course to get the owners of the buildings to carry out all energy saving measures that are recommended in the reports. Giving grants and loans for carrying out energy saving measures makes the implementation easier.

All the energy audits and recommended measures that are given grants are registered in an energy efficiency database. It is also registered which measures that are actually carried out.

To receive the grant the building owners has to establish a system for Energy Monitoring with weekly follow-up of the energy consumption. A minimum of six weeks of registration must be documented before the grant is paid off.

4.1.9 Auditing volumes

During the period 1990 to 2000 more than 1000 projects including audits have been supported in the non-residential sector, see Figure 10.

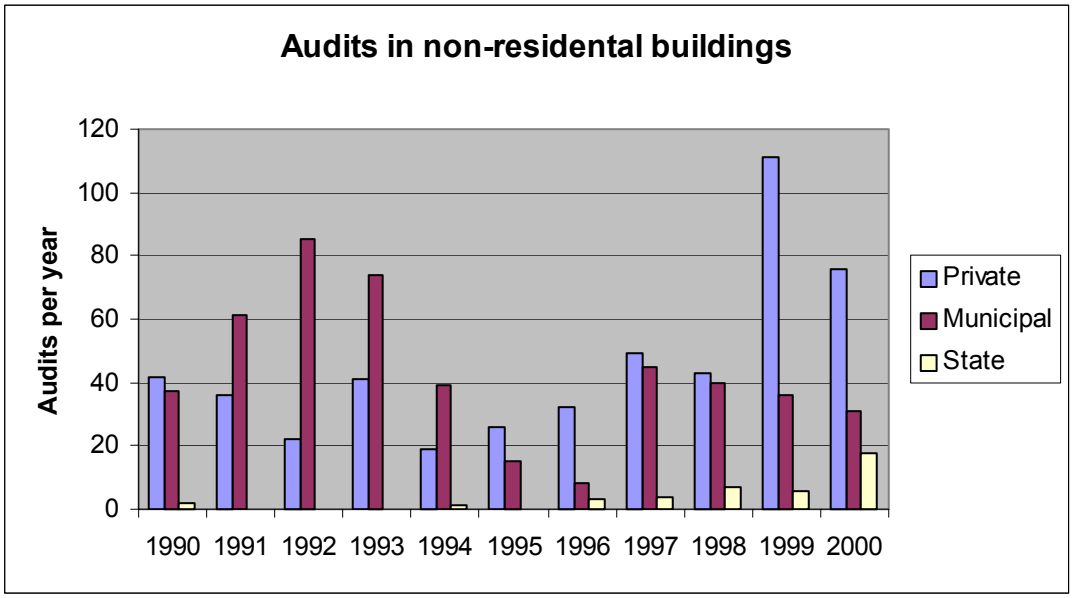


Figure 10. Number of audits completed with support from Oslo Econ Fund 1990-2000

The activity varies for a number of reasons. The size of the grant, economic situation generally, energy prices, media coverage of energy efficiency etc. It may look like a very low activity during the period from 1994-1996. This, however, has an explanation: There existed a national support scheme for energy efficiency measures. This meant that projects in Oslo received funds from this scheme, and did not receive funding from the Oslo Econ Fund.

In 1996, the support from the fund was doubled (for each measure implemented - the amount of support was doubled.) In addition to this change, energy prices in Norway soared as a result of less than usual precipitation. Media covered the "energy crises" and politicians demanded energy savings. This led to a bursting interest for energy efficiency and an increased number of applications for grants from the fund.

4.1.10 Results

The expected (calculated) savings have been compared to actual, measured savings through a number of projects in the 1980s.[2] In non-residential buildings, the actual savings match pretty well with the expected, calculated savings. This table shows the result for non-residential buildings. 50 % of all projects were audited.

	NON-RESIDENTIAL BUILDINGS
Specific energy use before EE (kWh/m2)	290
Specific energy use after EE (kWh/m2)	240
Actual reduction (kWh/ m2)	50
Actual reduction, percentage	17 %
Expected reduction	53
Expected reduction, percentage	18 %

[2] Evaluation of energy audits and accomplished measures, Oslo Enøk, April 1998.

It is interesting to see what measures are being supported. The figures listed under are from 1997 only. Before this - the different measures were not registered in the same manner. The figures show the distribution of the different measures in advance promises, not payments, for the same reason.

Ventilation	59 %
Heating plant	13 %
Building (insulation etc.)	11 %
Central control system	10 %
Other	7 %

The calculated savings in projects in the non-residential sector during the period 1998 to 2000 are in Figure 11.

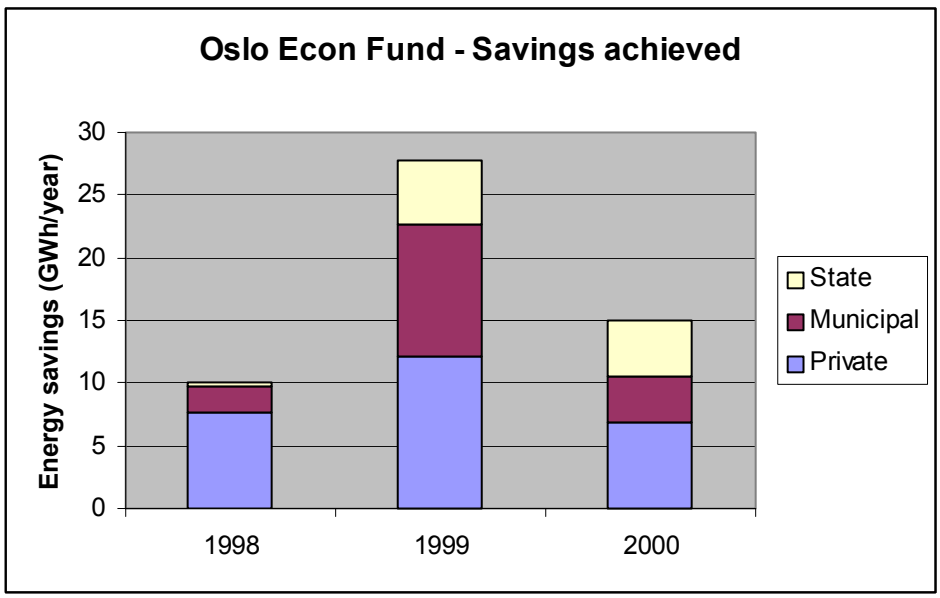


Figure 11. Savings achieved in the non-residential sector, 1998 - 3000

4.1.11 Programme evaluation

Stationary energy use is still increasing. Electricity use in Oslo has increased from 6 TWh in 1980 to about 9 TWh today. Clearly, the initial goal of "reducing electricity demand growth to zero" is not met.

At the moment there are no plans to do a systematic evaluation of the Energy Audit scheme. However, the system with the Oslo Econ fund and the budget set by the City Council will certainly be evaluated in the future.

4.1.12 Observations and future plans

Even if the initial goal of "reducing electricity demand growth to zero" were not met, it would be unfair to say that the fund has failed on this basis. It is extremely difficult to establish a base case to evaluate the success of the fund. What would the energy

consumption in Oslo be if the fund did not exist? Our comments here will not give a complete answer to this question.

As we have seen, the grants and loans made from the fund have been used for investments in energy efficiency projects. The expected savings matched the measured savings pretty well for non-residential buildings. The actual savings were smaller compared to the expected value for residential buildings, but energy savings were nevertheless achieved.

However, one question still remains: If the fund did not exist, would the projects still be carried out? In other words: How can one exclude those who would have implemented the energy efficiency measures without the grant? The Econ Fund of Oslo *partly* solves this problem by establishing minimum standards for the different measures. For instance, to obtain a grant if you replace your old windows, the insulation capacity of the new windows must be better than the most common windows on the market. That is: The windows would have been replaced either way, but the fund ensures that the quality is heightened. Similar minimum standards are required for other measures. A common view on the fund is that "the energy efficiency measures would have been carried out regardless of the fund, but the existence of minimum standards entails a better quality."

Furthermore, the experience also shows that the existence of the fund means more measures are implemented. For instance - in co-operative building societies, the fact that it is possible to get a grant funding sometimes is decisive for measures to get a majority vote. The reasons behind this, we believe, are a) it is always interesting to get something "for free" and b) the fact that you get a grant for doing something confirms that you are doing the right thing.

NORWAY:
Energy audits within the
Industrial Energy Efficieny
Network